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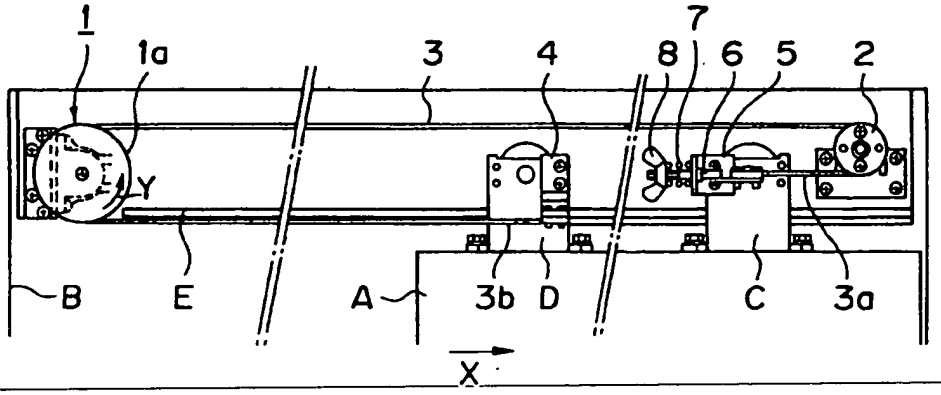
(54) Sliding door device.

(57) A door closer (1) and a driven pulley (2) are arranged opposite to the conventional arrangement, and a tension spring (7) is provided at a belt end (3a) retained at a roller unit (C) on the driven pulley side. The door closer (1) and the driven pulley (2) may be arranged in the same manner as in the conventional arrangement if the tension spring (7) is provided at a belt end (3a) retained at the roller unit (C) on the door closer side. Further, the door closer (1) and the driven pulley (2) may be arranged in the same manner as in the conventional arrangement if a short pipe (11) is provided so as to encase the tension spring (7) on the driven pulley side between a metallic member (5) and a nut (8). According to this invention, even if an external force is applied during a door closing operation, a tooth jump of a timing belt is avoided, a tooth jump preventing roller is dispensed with, and the number of the mechanical parts and the cost therefor may be reduced. The mounting work of the device may be simplified.

FIG.1A



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BACKGROUND OF THE INVENTION

The present invention relates to a sliding door device provided with a sliding door closer having a drum which contains a spring therein.

FIG. 3 shows a sliding door device disclosed in Japanese Patent Application Laid-Open No. Hei 2-256779. In this device, two roller units C and D provided on a sliding door A are laid on a suspension rail E formed on a door frame B. A sliding door closer 1 is provided on one side of the door frame B in the door closing direction, whereas a driven pulley 2 is provided on the other side thereof in the door opening direction. A timing belt 3 is wound around between the sliding door closer 1 and the driven pulley 2. Both ends 3a and 3b of the belt 3 are retained at the two roller units C and D by metallic members 4 and 5, respectively. A bolt 6 is coupled to the door opening side belt end 3b and passes through the metallic member 5 mounted on the roller unit D. In addition, a tension spring 7 is provided around the bolt 6. A nut 8 is threadedly engaged with the bolt 6 so that the tension spring 7 is compressed between the metallic member 5 and the nut 8 to thereby impart a biasing force to the timing belt 3. The timing belt 3 travels in response to the door closing operation of the sliding door A, so that a spring encased in a drum of the sliding door closer 1 is urged and the sliding door A is closed while the drum is being rotated under the brake force through a hydraulic dampening circuit by the spring bias force of the spring. A tooth-jump preventing roller 9 is mounted on a closer mounting member 10 which is used to mount the sliding door closer 1 onto the suspension rail E, whereby the timing belt 3 is prevented from being jumped away from the drum of the sliding closer 1. Due to the fact that the drum of the sliding door closer 1 is hydraulically controlled at a predetermined closing speed, when an external force is applied to the sliding door A in the door closing direction (as indicated by X) during the door closing operation, the door closer 1 is not rotated smoothly in the counterclockwise direction as indicated by Y because of the hydraulic resistance. As a result, the left end 3b of the belt 3 is pulled in the direction as indicated by Z and the tension spring 7 is compressed and at the same time, the timing belt 3 is temporarily loosened, especially at the right end 3a of the belt 3 in correspondence with the compression length of the tension spring 7, so that the timing belt 3 would be offset from the teeth formed on the outer periphery of the drum of the sliding door 1. The tooth-jump preventing roller 9 is provided for the purpose of preventing a trouble called "tooth-jump".

However, the tooth-jump preventing roller 9 suffers from a disadvantage that, during the mounting it at the site, there is a fear that the roller 9 itself would be lost and it would take a long working time for mounting it in place because the roller 9 is to be threadedly mounted on the closer mounting member 10 after the timing belt 3 has been wound around the drum of the sliding door closer 1. In addition, the closer mounting member 10 for mounting the sliding door closer onto the suspension rail E has a shape such that the member 10 may be mounted on the right/left sliding door A, resulting in the complicated configuration of the member 10.

SUMMARY OF THE INVENTION

Accordingly, in view of the foregoing defects, an object of the present invention is to provide a sliding door device wherein, even if an external force is applied to the door during the door closing operation, it is possible to avoid a tooth jump of a timing belt and it is possible to reduce the number of the necessary mechanical parts and the cost therefor to thereby simplify the mounting work and make the closer mounting member compact in size.

According to a first aspect of the invention, there is provided a sliding door device for a sliding door having a door frame, a suspension rail, and two rollers mounted on the suspension rail, comprising: a sliding door closer having a spring held within a drum and a hydraulic pressure dampening circuit, said sliding door closer being located at one end of the rail; a driven pulley provided at the other end of the rail; a timing belt wound between the door closer and a driven pulley with a first end and a second end of the timing belt being retained at the two rollers; and a tension spring for drawing one of the first and second ends of the timing belt, said spring of said sliding door closer accumulating a spring force in response to a door opening operation of the sliding door through the timing belt, said spring of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, wherein the sliding door closer is provided on one side in the door opening direction, the driven pulley is provided one side in the door closing direction, and the tension spring is provided at the belt end retained at the roller on one side in the door closing direction.

According to a second aspect of the invention, there is provided a sliding door device for a sliding door having a door frame, a suspension rail, and two rollers mounted on the suspension rail, comprising: a sliding door closer provided on one side in a door closing direction of the suspension rail, said door closer having a spring held within a drum and a hydraulic pressure dampening circuit; a driven pulley provided on one side in a door opening direction; a timing belt wound between the door closer, with a first end and a second end of the timing belt being retained at the two rollers; and a tension spring for drawing one of the first and second ends of the timing belt, said spring of said sliding door closer accumulating a spring force in response to a door opening operation of the sliding

door through the timing belt, said spring of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, wherein said tension spring is provided at the belt end retained at the roller on one side in the door opening direction.

According to a third aspect of the invention, there is provided a sliding door device for a sliding door having a door frame, a suspension rail, and two rollers mounted on the suspension rail, said sliding door device comprising: a sliding door closer having a spring held within a drum and a hydraulic pressure dampening circuit, said sliding door closer being located on one side in a door closing direction of the rail, a driven pulley provided at the other end of the rail, a timing belt wound between the sliding door closer and the driven pulley with a first end and a second end of the timing belt being retained at the two rollers, respectively, a tension spring for drawing one of the first and second ends of the timing belt, said spring of said sliding door closer accumulating a spring force in response to a door opening operation of the sliding door through the timing belt, said spring of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, characterized in that a restricting member is provided to restrict a shrinking motion of the tension spring.

According to the first aspect of the invention, the sliding door closer and the driven pulley are arranged opposite to the conventional arrangement thereof and the tension spring is located at the belt end retained at the roller on the driven pulley side, the external force to be applied in the door closing direction during the door closing operation is directly transmitted to the sliding door closer, so that the door sliding closer is rotated and the tension of the timing belt may be kept unchanged, thus avoiding the tooth jump of the timing belt.

According to the second aspect of the invention, although the door closer and the driven pulley are arranged in the same manner as in the conventional arrangement, the tension spring is provided at the belt end retained at the roller on the door closer side. When the external force is applied in the door closing direction during the door closing operation, the belt end retained at the roller on the door closer side is apt to be loosen. However, the tension spring connected to the belt end functions to pull the belt end to apply a tension thereon. Therefore, the loosening of the belt end can be avoided.

According to the third embodiment of the invention, although the door closer and the driven pulley are arranged in the same manner as in the conventional arrangement, a short pipe is provided so as to encase the tension spring between the metallic member and the nut. As a result, the external force to be applied in the door closing direction during the door closing operation is transmitted from the metallic member to the nut to keep the compression length of the tension spring unchanged and to avoid the loosening of the timing belt end to thereby prevent the tooth jump of the timing belt.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1A is a frontal view showing a primary part of a sliding door device according to a first embodiment of the invention;

FIG. 1B is a frontal view showing a primary part of a sliding door device according to a second embodiment of the invention;

FIG. 1C is a frontal view showing a primary part of a sliding door device according to a third embodiment of the invention;

FIG. 2 is a longitudinal sectional view showing a sliding door closer which is applicable to any one of the first to third embodiments of the invention; and

FIG. 3 is a frontal view showing a prior art sliding door device.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1A shows a sliding door device in accordance with a first embodiment of the invention. In the sliding door device, two roller units C and D provided at an upper end of the sliding door A are laid on a suspension rail E formed along an upper side of a door frame B. The sliding door closer 1 is provided on one side of the suspension rail E in the door opening direction, whereas a driven pulley 2 is provided on the other side of the suspension rail E in the door closing direction. A timing belt 3 is wound around between the sliding door closer 1 and the driven pulley 2. The left end 3b of the timing belt 3 which is wound around the door closer 1 is retained at a metallic member 4 mounted on the roller unit D on the sliding door side, whereas the right end 3a of the belt 3 is retained at a metallic member 5 mounted on the other roller unit C. A bolt 6 is coupled with the belt end 3a which is retained on the side of the roller unit C. The bolt 6 is inserted into the metallic member 5 mounted on the roller unit C. A tension spring 7 is wound around the bolt 6 which is threadedly engaged with a nut 8 to thereby compress the tension spring 7. Thus, when the sliding door A is opened, a spiral spring 1b (see FIG. 2) within a drum 1a of the sliding door closer 1 is biased in response to the door opening operation. The spring urged rotational force of the spring 1b causes the drum 1a to rotate in the door closing direction while being subject to a brake through a hydraulic dampening circuit so that the timing belt 3 travels to move the sliding door A in the door closing di-

rection.

FIG. 2 shows the sliding door closer 1. The sliding door closer 1 has a drum 1a which is connected coaxially to a drive shaft 1c by a screw s. The timing belt 3 is wound around the drum 1a to rotate it. The drum 1a has the spiral spring 1b therein. When the door is opened, a rotational torque for rotating the drum 1b in the door closing direction is accummulated in the spiral spring 1b. The drive shaft 1c has a screw portion 1j which is engaged with an inner surface 1k of a piston 1f in the form of a cap. The piston 1f is engaged with the screw portion 1j in a manner surrounding the screw portion 1j. The piston 1f is engaged with the housing 1d in a state wherein it can not be rotated but moved in the axial direction of a cylinder chamber 1e and has a check valve 1ℓ and a safety valve 1m in an annular side wall. On the left side of the piston 1f is formed an oil chamber 1e' and on the right side thereof is formed an oil chamber 1e" in the housing 1d. Further, between the inner surface of the bottom wall of the piston 1f and the end face of the screw portion 1j of the drive shaft 1c is provided an oil chamber 1n which is connected to the oil chamber 1e" through a spring receiving hole 1p for receiving a compression spring 1r and a small side hole 1q.

When the door is opened, the drive shaft 1c is rotated in the door opening direction to move the piston 1f to the right as viewed in FIG. 2. At this time, oil in the chambers 1n and 1e" flows into the chamber 1e' through the check valve 1ℓ. At this time, the compression spring 1r is compressed to apply a resistance against a door opening movement. Therefore, even when the door is strongly opened, the shock is alleviated. Thereafter, when the door is released, the drive shaft 1c is rotated in the door closing direction opposite to the door opening direction due to the repulsive force of the spiral spring 1b. At this time, the piston 1f is moved to the left to thereby cause the oil in the chamber 1e' to flow into the chamber 1e" through an adjusting valve (not shown). That is, when the door is closed, the flow rate of the oil is controlled by the adjusting valve to cause the door to close slowly and smoothly. If a shock is exerted on the oil circuit due to some causes, the safety valve 1m permits the oil in the chamber 1e' to flow into the chamber 1e" to release the oil circuit. Thus, the desired hydraulic dampening circuit is formed.

When the door is opened, an external force in the door opening direction is transmitted through the tension spring 7 to the nut 8 on the roller unit C and is further transmitted to the timing belt 3, so that the drum 1a of the sliding door closer 1 is rotated to thereby accumulate the spring force of the internal spring 1b. When the hand of the user is released away from the sliding door A in the door opened condition, the accumulated spring force of the spring 1b of the door closer 1 causes the drum 1a to rotate to thereby travel the timing belt 3 and to thereby close the sliding door A without any external force. However, when the door is closed, if some external force is applied to the sliding door A in the door closing direction X, the external force which is applied in the door closing direction X during the door closing operation is directly transmitted to the sliding door closer 1a through the left end 3b of the belt to rotate it in an counterclockwise direction Y. The rotation of the sliding door closer 1a applys a tension to the upper path of the belt 3 thereby to rotate the pulley 2. Then, the tension is transmitted to the right end 3a of the belt 3. However, since the door A is moved to the right at that time, a big force is not transmitted to the tension spring 7. Therefore, since the compression dimension of the tension spring 7 is kept unchanged and the tension of the timing belt 3 is almost kept unchanged at the right end 3a, there is no fear that the timing belt 3 is subjected to the tooth-jump at the drum 1a of the sliding door closer 1.

FIG. 1B shows a sliding door device in accordance with a second embodiment of the invention.

In the sliding door device, two roller units C and D provided at an upper end of the sliding door A are laid on a suspension rail E formed along an upper side of a door frame B. The sliding door closer 1 is provided on one side of the suspension rail E in the door closing direction, whereas a driven pulley 2 is provided on the other side of the suspension rail E in the door opening direction. A timing belt 3 is wound around between the sliding door closer 1 and the driven pulley 2. The right end 3a of the timing belt 3 which is wound around the door closer 1 is retained at a metallic member 5 mounted on the roller unit C on the sliding door closer side, whereas the left end 3b is retained at a metallic member 4 mounted on the other roller unit D. A bolt 6 is coupled with the belt end 3a which is retained on the side of the roller unit C. The bolt 6 is inserted into the metallic member 5 mounted on the roller unit C. A tension spring 7 is wound around the bolt 6 and is threadedly engaged with a nut 8 to thereby compress the tension spring 7. Thus, when the sliding door A is opened, the spring 1b (see FIG. 2) within the drum 1a of the sliding door closer 1 is biased in response to the door opening operation. The spring urged rotational force of the spring 1b causes the drum 1a to rotate in the door closing direction while being subjected to a brake through a hydraulic dampening circuit so that the timing belt 3 travels to move the sliding door A in the door closing direction.

When the external force for closing the sliding door A during the door closing operation is applied, the door closer 1 is not smoothly rotated as explained in BACKGROUND OF THE INVENTION. Therefore, the right end 3a of the belt 3 is going to loosen. However, the tension spring 7 pulles the right end 3a to the left to apply a tension to the right end 3a thereof. Therefore, the tension of the timing belt 3 is maintained, so that any loosening on the belt end 3a is not

allowed. Therefore, even if the external force is applied to the drum 1a of the sliding door closer 1 during the door closing operation, it is possible to avoid the tooth jump of the timing belt.

FIG. 1C shows a sliding door device in accordance with a third embodiment of the invention. In the sliding door device, two roller units C and D provided at an upper end of the sliding door A are laid on a suspension rail E formed along an upper side of a door frame B. The sliding door closer 1 is provided on one side of the suspension rail E in the door closing direction, whereas a driven pulley 2 is provided on the other side of the suspension rail E in the door opening direction. A timing belt 3 is wound around between the sliding door closer 1 and the driven pulley 2. The end 3a of the timing belt 3 which is wound around the door closer 1 is retained at a metallic member 4 mounted on the roller unit C on the side of the sliding door closer 1, whereas the other end 3b is retained at a metallic member 5 mounted on the other roller unit D. A bolt 6 is coupled with the belt end 3b which is retained on the side of the roller unit D. The bolt 6 is inserted into the metallic member 5 mounted on the roller unit D. A tension spring 7 is wound around the bolt 6, encased within a short solid pipe 11 as a restricting member for restricting the shrinking motion of the spring 7 over a predetermined length, and threadedly engaged with a nut 8. Thus, when the sliding door A is opened, the spring 1b (see FIG. 2) within the drum 1a of the sliding door closer 1 is biased in response to the door opening operation. The spring urged rotational force of the spring 1b causes the drum 1a to rotate in the door closing direction while being subjected to a brake through a hydraulic dampening circuit so that the timing belt 3 travels to move the sliding door A in the door closing direction.

When the external force for closing the sliding door A is applied to the sliding door A during the door closing operation, the left end 3b of the belt 3 is pushed in the direction Z as explained in BACKGROUND OF THE INVENTION. However, the movement of the nut 8 is stopped by the pipe 11 thereby not permitting the spring 7 to shrink. Therefore, the length of the tension spring 7 is kept unchanged so that the tension of the timing belt is kept. Any loosening of the tension spring 7 will not occur. Thus, the tooth jump of the timing belt 3 may be avoided.

As described above, according to any of the first to third embodiments of the invention, even if the external force is applied to the door during the door closing operation, any tooth jump of the timing belt will not occur. Thus, a tooth jump preventing roller may be dispensed with. It is possible to reduce the number of the mechanical parts and the cost therefor. The assembling work may be simplified. Furthermore, the closer mounting members may be made compact in size.

Claims

1. A sliding door device for a sliding door having a door frame, a suspension rail for guiding the sliding door, and at least two rollers provided on the door frame and mounted on the suspension rail, said sliding door device comprising:

   a sliding door closer (1) having a spring (1b) held within a drum (1a) and a hydraulic pressure dampening circuit, said sliding door closer being located at one end of the rail (E);

   a driven pulley (2) provided at the other end of the rail (E);

   a timing belt (3) wound between the door closer (1) and the driven pulley (2) with a first end and a second end of the timing belt (3) being retained at the two rollers, respectively; and

   a tension spring (7) for drawing one of the first and second ends of the timing belt;

   said spring (1b) of said sliding door closer (1) accumulating a spring force in response to a door opening operation of the sliding door (A) through the timing belt (3), said spring (1b) of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, characterized in that

   the sliding door closer (1) is provided on one side in the door opening direction, the driven pulley (2) is provided on one side in the door closing direction, and the tension spring (7) is provided at the belt end retained at the roller on one side in the door closing direction.

2. A sliding door device according to claim 1, wherein said sliding door closer (1) has a drive shaft (1c) connected to the drum (1a), which has a screw portion (1j) for engaging with a piston (1f) so as to move the piston (1f) in response to a rotation of the drum (1a), the piston is in the form of a cap so as to surround the screw portion (1j) of the drive shaft, and a compression spring (1r) is provided between the screw portion (1j) and the piston (1f) so as to shrink and expand in response to the rotation of the drum (1a).

3. A sliding door device according to claim 2, wherein said compression spring (1r) is accommodated in a hole (1P) of the screw portion (1j), and the hole (1P) is connected to a cylindrical chamber formed in a housing (1d) for accommodating the drive shaft (1c) therein.

4. A sliding door device for a sliding door having a door frame, a suspension rail for guiding the sliding door, and at least two rollers provided on the door frame and mounted on the suspension rail, said sliding door device comprising:

a sliding door closer (1) having a spring (1b) held within a drum (1a) and a hydraulic pressure damping circuit, said sliding door closer being provided on one side in a door closing direction of the suspension rail (E);

a driven pulley (2) provided on one side in a door opening direction;

a timing belt (3) wound between the door closer and the driven pulley (2) with a first end and a second end of the timing belt (3) being retained at the two rollers, respectively, and;

a tension spring (7) for drawing one of the first and second ends of the timing belt (3), said spring (1b) of said sliding door closer accumulating a spring force in response to a door opening operation of the sliding door through the timing belt (3), said spring (1b) of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, characterized in that

said tension spring (7) is provided at the belt end (3a) retained at the roller on one side in the door closing direction.

5. A sliding door device according to claim 4, wherein said sliding door closer (1) has a drive shaft (1c) connected to the drum (1a), which has a screw portion (1j) for engaging with a piston (1f) so as to move the piston (1f) in response to a rotation of the drum (1a), the piston is in the form of a cap so as to surround the screw portion (1j) of the drive shaft, and a compression spring (1r) is provided between the screw portion (1j) and the piston (1f) so as to shrink and expand in response to the rotation of the drum (1a).

6. A sliding door device according to claim 5, wherein said compression spring (1r) is accommodated in a hole (1P) of the screw portion (1j), and the hole (1P) is connected to a cylindrical chamber formed in a housing (1d) for accommodating the drive shaft (1c) therein.

7. A sliding door device for a sliding door having a door frame, a suspension rail for guiding the sliding door, and at least two rollers provided on the door frame and mounted on the suspension rail, said sliding door device comprising:

a sliding door closer (1) having a spring (1b) held within a drum (1a) and a hydraulic pressure dampening circuit, said sliding door closer being located on one side in a door closing direction of the rail (E);

a driven pulley (2) provided on one side in a door opening direction;

a timing belt (3) wound between the sliding door closer (1) and the driven pulley (2) with a first end and a second end of the timing belt (3) being retained at the two rollers, respectively,;

a tension spring (7) for drawing one of the first and second ends of the timing belt;

said spring (1b) of said sliding door closer (1) accumulating a spring force in response to a door opening operation of the sliding door through the timing belt (3), said spring of said sliding door closer releasing the spring force while being braked by said hydraulic dampening circuit during a door closing operation, characterized in that the tension spring (7) is provided on a roller on one side in a door opening direction and

a restricting member (11) is provided to restrict a shrinking motion of the tension spring (7).

8. A sliding door device according to claim 7, wherein a bolt (6) is coupled to a first end (3b) of the timing belt (3) and inserted into a metallic member (5) mounted on a roller, said tension spring being provided around the bolt (6), a nut being engaged with said bolt (6), said tension spring (7) being compressed and interposed between the metallic member and the nut to impart a tension to the timing belt (3), said restricting member (11) being provided so as to encase said tension spring (7) between the metallic member (5) and the nut (8).

9. A sliding door device according to claim 8, wherein said restricting member comprises a solid short pipe (11).

FIG.1A

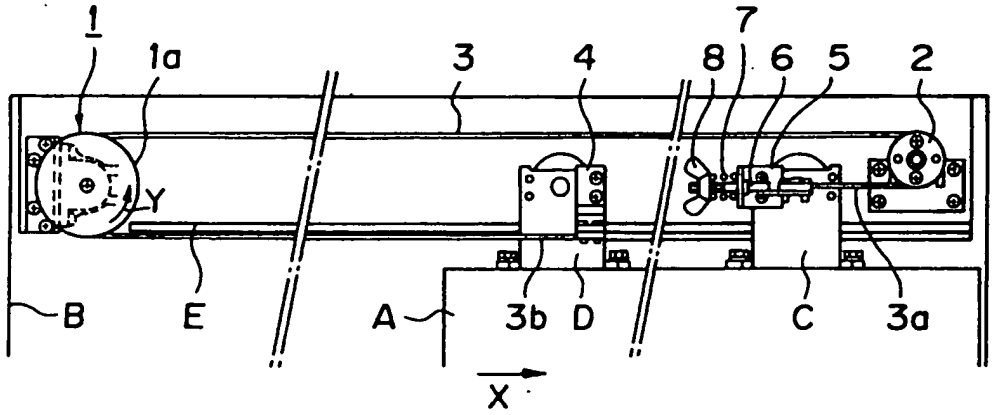

FIG.1B

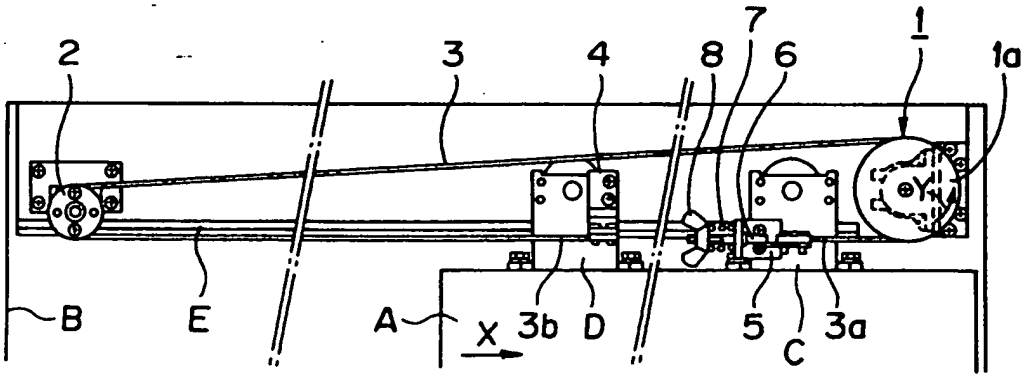

FIG.1C

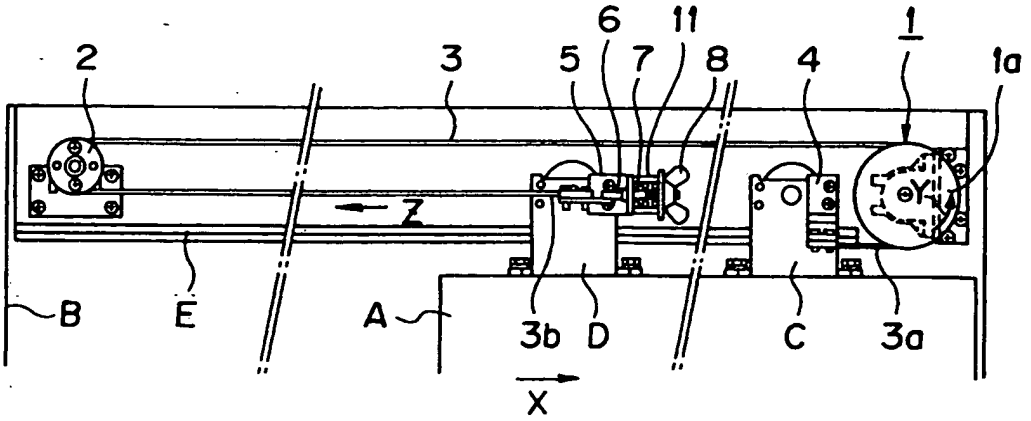

FIG. 2

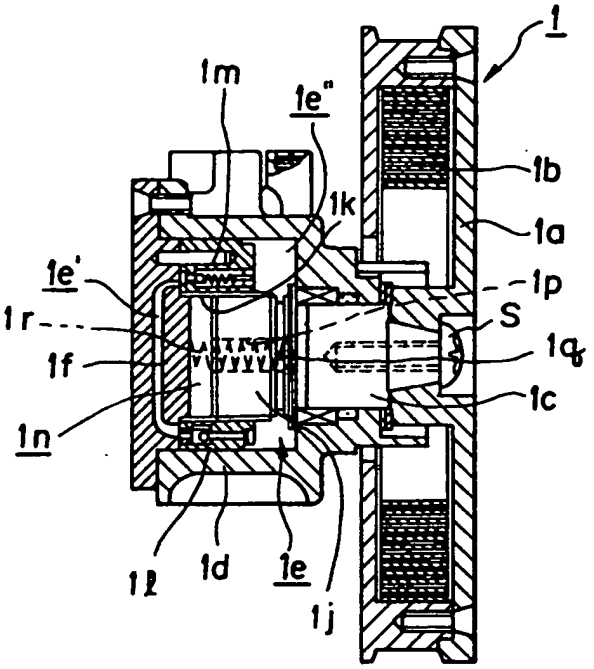
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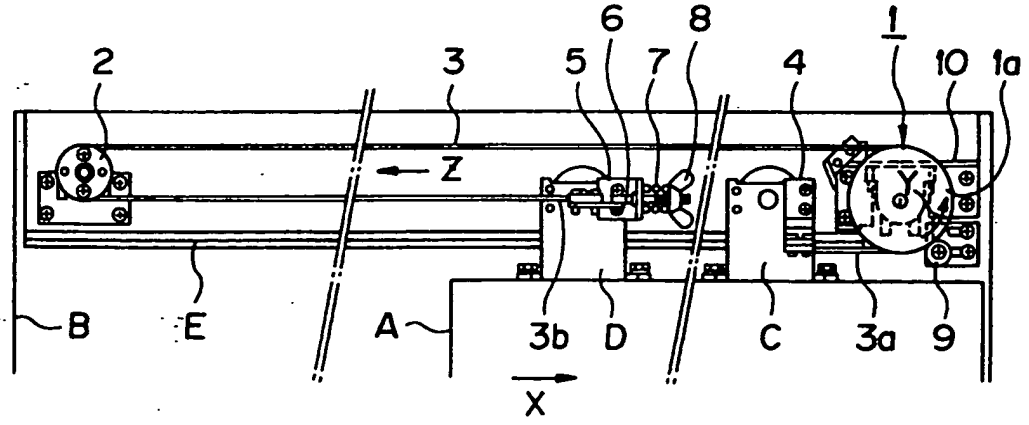
FIG. 3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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 93 30 2837

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A,D	PATENT ABSTRACTS OF JAPAN vol. 15, no. 6 (M-1066)(4534) 8 January 1991 & JP-A-22 56 779 (SANWA SHUTTER CORP) 17 October 1990 * abstract *	1	E05F1/08 E05F3/08
A	US-A-4 330 960 (W. HASEMANN ET AL) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			E05F E05D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	27 JULY 1993	DELZOR F.N.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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